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17. ABSTRACT (MAX. 250 WORDS)

The report of a study undertaken by the Student Counseling Center at K.S.U. to determine whether the present orientation test (A.C.T.) can predict (within reasonable error) the grades in several freshman courses. The courses chosen constituted all the first-semester courses at Kansas State University for the fall of 1960 with an enrollment of 100 or more freshmen who had taken the A.C.T.

The multiple-regression technique was used to develop prediction equations for nine courses. The predictors studied were the four subtests of the A.C.T. (English, mathematics, social studies, and natural sciences) and, in some cases, the high school grade in the same or in a related subject.

Findings are accompanied by detailed statistical tables.

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Student Counseling Center

Kansas State University

Studies in Student Personnel Work

Research Report #20

PREDICTING COURSE GRADES WITH THE A.C.T.

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Office of Education

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January, 1962

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INTRODUCTION

The philosophy of the Counseling Center concerning aptitude testing is mainly utilitarian: a test is worthwhile only in so far as it gives the testee information about himself which will be useful to him in making decisions about his educational and vocational future. In an attempt to maximize the information obtainable from such tests (i.e. to go beyond the rank ordering of students in various aptitude areas), several studies have been carried out by the staff of the Counseling Center in recent years to determine the effectiveness of various batteries of aptitude tests at predicting scholastic success at KSU (see Research Reports 12, 16 and 17). All of these have dealt with the prediction of first-semester or first-year grade point averages.

However, it is a common observation that a student's achievement generally will not be the same in all areas -- he might get at "A" in a social science course and a "C" in a mathematics course, or vice versa. In the past there have been no data for estimating probable achievement in different KSU courses. Making such data available can give students information to assist in such decisions as: "In what curricula do I have the greatest chances for success?" "What are the odds that I'll get a particular grade in various courses?" "How hard and effectively will I have to study for particular courses?" "Need I consider arranging my schedule so that I will take courses with my lowest probability for success in different semesters?" Etc. If data for such decisions can be obtained, it should be of help both to students already at the University and to those considering attendance at KSU. This study was undertaken for the purpose of developing equations for making sub-tests of the ACT as predictors.

PURPOSE

The purpose of this study was to determine whether the present orientation test (The American College Test -- ACT*) can predict (within reasonable error) grades in several courses typically taken by freshmen.

PROCEDURE

The multiple regression technique was used to develop prediction equations for nine courses. The predictors studied were the four sub-tests of the ACT (English, Mathematics, Social Studies, Natural Sciences) and, in some cases, the high school grade in the same or in a related subject.

The courses chosen constituted all the first-semester freshman courses for the Fall of 1960 with an enrollment of 100 or more freshmen who had taken the ACT. Regression equations were developed separately for men and women in those courses in which the number was large enough. The nine courses studied were:

English Composition I -- Men and women separately

Oral Communications I -- Men and women separately

College Algebra -- Primarily men

Calculus I -- Primarily men

Chemistry I -- Primarily men

General Chemistry -- Primarily women

Man's Physical World -- Separate analyses for men and women

Accounting I -- Men and women combined

General Psychology -- Men and women separately

RESULTS

Readers of this report interested just in the highlights of the statistical

*Brief descriptions of the ACT are available from the Counseling Center, upon request.

analyses are referred to Tables I - III below. These summarize the more detailed analyses which are presented in Tables IV - XVI at the end of the report.

What Predicts Grades in Nine Freshman Courses?

Table I summarizes the weights each variable carries in predicting grades in the courses studied.

The Table reports, for predicting men's grades in English Composition ("Eng. Comp.-M"): When grade in high school English is included in the prediction, score on the ACT-English test is most important, with ACT-Social studies score, high school English grade and ACT-Math score contributing decreasingly less to the prediction and ACT-Natural Science score not contributing in any significant way to the prediction. Making predictions on the ACT only, the order of importance is ACT-English, ACT-Social Studies and ACT-Math, with ACT-Natural Science dropping from the prediction.

Table I

Weights Carried by Each Variable in Course Predictions
(Standard B-Values for Predictor Variables)

Course (by sex)	Predictor Weights: ACT plus High School Grade					ACT only			
	ACT Eng.	ACT Math	ACT SS	ACT NS	H.S. Grade	ACT Eng.	ACT Math	ACT SS	ACT NS
Eng. Comp.-M	.366	.101	.196	----	.151	.406	.125	.217	----
Eng. Comp.-W	.229	.111	.237	----	.269	.281	.188	.268	----
Oral Comm.-M	.176	----	.197	----	.190	.233	----	.241	----
Oral Comm.-W	----	----	.284	----	.304	----	----	.405	.000+
Col. Alg.-M	.174	.443	----	----	.367	not computed			
Calc. I-M	not computed - H.S. grade					.378	.266	----	----
Chem I-M	.256	.400	.243	----	.263*	.264	.414	.262	----
Gen. Chem-W	----	----	----	----	----	.321	.291	.271	----
P. World-M	----	----	----	----	----	----	.322	.418	----
P. World-W	----	----	----	----	----	----	.290	.435	----
Acc'ting-M&W	----	----	----	----	----	----	.295	.456	----
Gen. Psych.-M	----	----	----	----	----	----	.210	.312	----
Gen. Psych.-W	----	----	----	----	----	----	.249	.539	----

*simply whether or not had chemistry in high school

Table I shows:

1. No one variable accounts for performance in any one course. In English composition, for example, grades are related to three ACT tests -- English, Math and Social Studies -- plus high school English grade, when available. Or, in Chemistry I, the grades students get are related to scores on the English, Mathematics and Social Studies ACT tests.
2. The ability required for success in a course is not always obvious. In Calculus I for example, scores in the ACT English test carry more weight (.378) than do scores on the ACT Math test (.266). In predicting English Comp. grades for Women, ACT Social Studies score carries about the same weight as ACT English score.

3. ACT Math and Social Studies tests seem to involve abilities related to an extremely wide range of courses. Social Studies scores were included in 16 of the 18 prediction equations, and carried the greatest weight in 8 of the 16 equations. Math scores were included in 14 equations, but carried the heaviest weight in only one (algebra).
4. The most accurate statements about probable grades in any one course take into account the several variables reported in Table I. For this reason, the Counseling Center now reports, in addition to test scores, probability statements for courses based on a combination of the predictor weights by courses, as reported in Table I.

How Well Do These Variables Predict Course Grades?

Table II shows the correlations of grades in each course with both the single variables and the combination of variables (or multiple correlation). For example, the first row of the Table shows that men's grades in English Composition correlated .60 with ACT English test score, .46 with ACT Math, .53 Social Studies, .46 with ACT Natural Science and .42 with high school English grade. The multiple correlation (including high school grade) was .65 and with ACT sub-tests only was .64.

Table II

Correlation of Predictors With Course Grades

Course (by sex)	Predictor Variables					Multiple Correlations*	
	ACT Eng	ACT Math	ACT SS	ACT NS	H.S. Grade	With HSGrade	ACT only
Eng. Comp-M	.60	.46	.53	.46	.42	.65	.64
Eng. Comp-W	.53	.46	.53	.48	.50	.66	.62
Oral Comm-M	.45	.32	.45	.38	.41	.54	.50
Oral Comm-W	.31	.27	.45	.35	.46	.55	.45
Col. Alg-M	.40	.54	.35	.27	.48	.62	---
Calc. I-M	.38	.34	.31	.29	.21	---	.42
Chem I-M	.51	.55	.50	.49	.29	.67	.64
Gen Chem-W	.53	.47	.50	.45	.11	---	.62
P.World-M	.46	.49	.55	.52	---	---	.62
P.World-W	.45	.53	.61	.49	---	---	.66
Acc'ting-M&W	.38	.39	.45	.36	---	---	.48
Gen.Psych-M	.38	.40	.55	.47	---	---	.58
Gen.Psych-W	.41	.48	.63	.51	---	---	.66

*For predictors retained and weights, see Tables I and IV - XVI.

The key figures in Table II are those found in the last two columns (the multiple correlations) as course predictions are made from the combinations of variables giving these correlations. An inspection of these columns shows that the correlations are about as high as could be expected (about .60 or higher) with three exceptions. These three are Oral Communications, Calculus I and Accounting I. It is difficult to know why grades in these courses are less predictable than those in other courses. Probably the predictor variables used in this study do not tap key abilities. Also, there could be something about the grading of these courses which was not taken into account in this study. Additional research being carried on by the Counseling Center on non-intellectual factors as related to academic performance may identify some of the factors affecting the lack of predictability.

Should the University be Concerned About Sex Effects and Grading Differences?

After extensive research, we've come to the conclusion that there is an ability difference between men and women. Table III reports means and standard deviations on predictor variables for students in each of the courses, along with mean grades in the college course, and the comparable standard deviation. For example, the men in English Composition averaged 17.2,22.1,20.3 on the three key ACT tests and averaged 2.65 (2.0=C, 3.0=B, etc) in high school English courses. Their average grade in English Composition at K-State was 1.46 (2.0=C, 3.0=B, etc.).

Table III

Means and Standard Deviations
for Predictor Variables and Course Grades

Course (by sex)		Predictor Variables: ACT Eng	ACT Math	ACT SS	ACT NS	H.S. Grade*	College Course Grades*
Eng. Comp-M	M	17.2	22.1	20.3	--	2.65	1.46
	sd	4.46	5.62	5.60	--	0.88	1.00
Eng. Comp-W	M	19.5	17.9	20.3	--	3.21	2.17
	sd	4.24	5.59	5.18	--	0.77	0.98
Oral Comm-M	M	17.5	--	20.7	--	2.68	1.97
	sd	4.49	--	5.84	--	0.88	0.85
Oral Comm-W	M	--	--	20.6	20.1	3.25	2.56
	sd	--	--	5.41	6.24	0.76	0.90
Col. Alg-M	M	17.8	23.1	--	--	2.99	2.15
	sd	3.93	4.02	--	--	0.85	1.25
Calc I-M	M	19.0	26.9	--	--	--	2.09
	sd	4.64	3.93	--	--	--	1.34
ChemI-M	M	17.9	23.6	21.3	--	**	2.3
	sd	4.52	5.00	5.37	--		1.22
Gen. Chem-W	M	19.0	18.1	19 9	--	--	2.23
	sd	4.41	5.50	5.10	--	--	1.16
P.World-M	M	--	17.6	18.1	--	--	2.10
	sd	--	5.25	5.79	--	--	1.02
P.World-W	M	--	17.2	20.1	--	--	1.91
	sd	--	4.96	4.85	--	--	0.95
Acc'ting-M&W	M	--	18.3	17.6	--	--	2.02
	sd	--	5.29	5.31	--	--	1.36
Gen.Psych-M	M	--	16.2	20.0	--	--	1.71
	sd	--	3.99	5.20	--	--	1.10
Gen.Psych-W	M	--	17.6	20.3	--	--	2.22
	sd	--	5.67	5.08	--	--	1.04

*4.0=A, 3.0=B, 2.0=C, 1.0=D, 0.0=F
**Whether or not Chemistry taken in high school

It is difficult to resist the temptation to raise some questions about the implications of data in Table III. Only two are enumerated below:

1. There are two aspects of sex differences (1) What are the differences? (2) What are the implications of these to the University? First, the differences. Women's grades are higher than men's in general in social science and humanities (verbal or linguistic) courses. The K-State grades of Women (as a group) are half a letter grade higher than men in English composition, oral communication, and general psychology. This superior performance is greater than can be accounted for by test score differences. Conversely, results indicate that women, in general, lose their superiority in the physical sciences. The women in Man's Physical World have higher scores on the key predictor (ACT Social Studies) yet get grades averaging slightly lower than those of men. Research supports this sex-image difference--women identify more with (and are identified by our society with) the verbal areas as opposed to men who generally are expected to be ahead of women in quantitative areas.

Second, what are the implications of this sex-image (or cultural) difference for college performance? It appears to interferes with a willingness of one sex to "become exposed" to courses in the "other sex's" area. It may make partly inoperative any university objectives aimed at broadening the cultural knowledge of students. However, it may be possible to attenuate the effects of this sex-image. Recent research has shown that colleges differ in the climates provided for students. Is there something in the "K-State climate" which supports this sex difference? Are there ways of developing a climate more conducive to exploring subjects in the "other sex's" area?

2. There is a suggestion of the universal problem of differences in grading standards. In this study, the students in college algebra average lower on ACT tests than those in Calculus I, yet received higher grades, in general.

   What are possible effects on this? Does the more able student get penalized? Do the effects of different grading standards interfere with possible university goals that encourage able students to take accelerated programs?

3. Women are more predictable than men, academically. That is, the variability (standard deviation) for women is generally smaller than for men, when comparisons can be made within the same course.

The main concern of this study was to determine if the ACT sub-tests can predict performance in various courses with only a reasonable amount of error. Tables IV-XVI report the results of the statistical analyses involved in developing these course predictions.

The first table for each course shows the means and standard deviations for the ACT sub-tests, grade in relevant high school course (in some cases), and the college course grade as well as the intercorrelations between these variables.

From the data shown in these tables (Phase I data) the regression ('prediction') equations were developed. In cases where a high school course grade is used, two regression equations are given - one using the high school course grade and one omitting it. The equations involving the high school course grades will not be generally useful until such time as transcript data are put on IBM cards.

The second and third (where appropriate) tables for each course presents the regression equations and the accompanying values of F and t. (Both F and I test

the significance of the reduction in variation associated with a given variable, but the t-test is a test of significance in reduction of variation after all other variables in the equation have been taken into account - F, on the other hand, will vary with the position of the variable in the equation. In this study we included only those variables for which both the F-test and the t-test were significant.) These tables also give the multiple correlation (R) and its standard error ($S.E._R$).

Table IV

ENGLISH COMPOSITION - MEN
N=617

	ACT I	ACT III	IV	HS Eng IV Grade	Eng Comp Grade	mean	std. dev.
ACT I	.55	.62	.58	.43	.60	17.21	4.46
II		.55	.56	.38	.46	22.07	5.62
III			.72	.39	.53	20,33	5.60
IV				.35	.46	21.05	5.96
HS Eng Comp Grade					.42	* 3.65	0.88
						x 1.46	1.00

Table IVa

Variables	B Values	F	T	
ACT I	.0800	337.96	8.42	R = .651
II	.0180	24.80	2.57	$S.E._R$ = .765
III	.0350	26.90	4.72	
HS Eng	.1715	18.48	4.30	

^{x}Y-intercept = -1.6509

Table IVb

Variable	B Value	F	T	
ACT I	.0886	337.96	9.42	R = .637
II	.0223	24.80	3.17	$S.E._R$ = .776
III	.0388	26.90	5.19	

x Y intercept = -1.3462

*F = 1, D = 2, C = 3, B = 4, A = 5

xModified so that F = 0, D = 1, C = 2, B = 3, A = 4

Table V

ENGLISH COMPOSITION - WOMEN
N=420

	ACT II	ACT III	ACT IV	HS Eng III Grade	Eng Comp Grade	mean	std dev
ACT I	.48	.55	.50	.39	.53	19.49	4.24
II		.49	.54	.43	.46	17.87	5.59
III			.71	.36	.53	20.25	5.18
~~HS Eng~~ HS ENG				.32	.48	19.66	5.61
Eng. Comp. Grade					.50	* 4.21	0.77
						x 2.12	0.98

Table Va

Variable	B Value	F	t
ACT I	.0540	162.55	4.98
II	.0199	35.51	2.49
III	.0457	31.30	5.16
HS Eng III Grade	.3480	42.19	6.50

$R = .663$
$S.E._R = .738$

x Y intercept = -1.6749

Table Vb

Variable	B Value	F	t
ACT I	.0662	162.55	5.91
II	.0336	35.51	4.14
III	.0517	31.30	5.59

$R = .619$
$S.E._R = .774$

x Y intercept = -0.8121

* F = 1, D = 2, C = 3, B = 4, A = 5

x Modified so that F = 0, D = 1, C = 2, B = 3, A = 4

Table VI

ORAL COMMUNICATION - MEN
N=398

	ACT II	ACT III	ACT IV	HS Eng III Grade	Oral Comm Grade	MEAN	Std dev.
ACT I	.58	.60	.57	.44	.45	17.46	4.49
II		.54	.59	.41	.32	22.75	5.86
III			.76	.41	.45	20.74	5.84
IV				.38	.38	21.33	6.20
HS Eng III Grade					.41	* 3.68	0.88
Oral Comm Grade						x 1.97	0.85

Table VIa

Variable	B Value	F	t
ACT I	.0391	98.72	3.77
III	.0338	27.28	4.30
HS Eng III Grade	.2141	21.63	4.65

x Y intercept = -0.2050

R = .539
$S.E._R$ = .716

Table VIb

Variable	B Value	F	t
ACT I	.0519	98.72	5.05
III	.0413	27.28	5.22

x Y intercept = 0.2048

R = .501
$S.E._R$ = .734

* F = 1, D = 2, C = 3, B = 4, A = 5

x Modified so that F = 0, D = 1, C = 2, B = 3, A = 4

Table VII

ORAL COMMUNICATION - WOMEN
N=209

	ACT II	ACT III	ACT IV	HS Eng III Grade	Oral Comm Grade	Mean	std dev
ACT I	.53	.55	.54	.42	.31	19.71	4.15
II		.54	.66	.42	.27	18.79	5.90
III			.77	.40	.45	20.64	5.41
IV				.31	.35	20.11	6.24
HS Eng III Grade					.46	* 4.25	0.76
Oral Comm Grade						x 2.56	0.90

Table VIIa

Variable	B Value	F	t
ACT III	.0525	53.04	4.99
HS Eng III Grade	.4021	28.56	5.34

x Y intercept = -9.2287

R = .549
$S.E._R$ = .754

Table VIIb

Variable	B Value	F	t
ACT III	.0749	53.04	4.87
IV	.0000	00.00	0.00

x Y intercept = 1.0194

R = .452
$S.E._R$ = .804

* F = 1, D = 2, C = 3, B = 4, A = 5

x Modified so that F = 0, D = 1, C = 2, B = 3, A = 4

Table VIII

COLLEGE ALGEBRA - N=155
(128 men, 27 women)

	ACT II	ACT III	ACT IV	HS Algebra Grade	College Alge Grade	mean	std dev
ACT I	.47	.53	.47	.34	.40	17.77	3.93
II		.45	.43	.40	.54	23.10	4.02
III			.65	.22	.35	20.53	5.02
IV				.08	.27	22.11	5.36
HS algebra I Grade					.48	* 3.99	0.85
College algebra grade						x 2.15	1.25

Table VIIIa

Variable	B Value	F	t
ACT I	.0443	29.80	1.89
II	.1102	34.42	4.68
HS Algebra I Grade	.4328	17.08	4.13

x Y intercept = -2.9065

R = .622
$S.E._R$ = .992

Table IX

CALCULUS I - N=171
(161 men, 10 women)

	ACT II	ACT III	ACT IV	HS Algebra I Grade	Calculus I Grade	mean	std dev
ACT I	.51	.55	.59	.21	.38	18.99	4.64
II		.43	.50	.23	.34	26.85	3.93
III			.71	.17	.31	23.36	5.00
IV				.06	.29	23.85	5.42
HS algebra I Grade					.21	* 4.30	0.83
Calculus I Grade						x 2.09	1.34

Table IXa

Variable	B Value	F	t
ACT I	.0815	29.26	3.49
II	.0678	6.03	2.46

x Y intercept = -1.2811

R = .421
$S.E._R$ = 1.220

* F = 1, D = 2, C = 3, B = 4, A = 5

x Modified so that F = 0, D = 1, C = 2, B = 3, A = 4

Table X

CHEMISTRY I - N=497
(444 men, 53 women)

	ACT II	ACT III	ACT IV	HS Chem (yes=1/no=0)	Chem I Grade	mean	std dev
ACT I	.49	.59	.57	.10	.51	17,87	4.52
II		.47	.48	.10	.55	23.60	5.00
III			.70	.11	.50	21.30	5.37
IV				.19	.49	22.23	5.68
HS Chem (yes=1, no=0)					.29	*	
Chem I Grade						x 2.03	1.22

Table Xa

Variable	B Value	F	t
ACT I	.0566	174.83	4.80
II	.0799	90.53	8.21
III	.0453	23.06	4.62
HS Chem	.7413	40.60	6.37

x Y intercept = -2.4642

R = .670
$S.E._R$ = .910

Table Xb

Variable	B Value	F	t
ACT I	.0583	174.83	4.75
II	.0827	90.53	8.18
III	.0488	23.06	4.80

x Y intercept = -1.9974

R = .635
$S.E._R$ = .945

* F = 1, D=2, C = 3, B = 4, A = 5

x Modified so that F = 0, D = 1, C = 2, B = 3, A = 4

Table XI

GENERAL CHEM - N=149
(11 men, 138 women)

	ACT LL	III	IV	HS Chem (yes-no)	Gen Chem Grade	MEAN	std dev
ACT I	.45	.58	.49	.02	.53	19.03	4.41
II		.40	.36	.00	.47	18.07	5.50
III			.70	.02	.50	19.89	5.10
IV				.06	.45	19.51	5.43
HS Chem (yes=1/no=0)					.11	*	
Gen Chem Grade						x 2.23	1.16

Table XIa

Variable	B Value	F	t
ACT I	.0729	52.47	3.31
II	.0529	15.33	3.37
III	.0532	8.13	2.85

x Y intercept = -1.1672

R = .617

$S.E._R$ = .921

Table XII

MAN'S P WORLD - MEN
N=116

	ACT II	III	IV	P Workd Grade	mean	std dev
ACT I	.56	.66	.56	.46	15.78	4.45
II		.43	.49	.49	17.63	5.25
III			.73	.55	18.13	5.79
IV				.52	18.25	5.82
P World Grade					x 2.10	1.02

Table XIIa

Variable	B Valve	F	t
ACT II	.0614	36.86	3.87
III	.0722	25.18	5.02

x Y intercept = -0.2875

R = .618

$S.E._R$ = .806

* F = 1, D = 2, C = 3, B = 4, A = 5

x Modified so that F = 0, D = 1, C = 2, B = 3, A = 4

Table XIII

MAN'S P WORLD - WOMEN
N=172

	ACT II	III	IV	P World Grade	mean	std dev
ACT I	.48	52	47	45	19.56	4.25
II		48	53	53	17.21	4.96
III			65	61	20.09	4.85
IV				49	18.90	5.27
P World Grade					x 1.91	0.95

Table XIIIa

Variable	B Value	F	t
ACT II	.0584	65.03	4.65
III	.0897	48.78	6.98

x Y intercept = -0.8936

R = .662
$S.E._R$ = .714

Table XIV

ACCOUNTING - N=103
(71 men, 32 women)

	ACT II	III	IV	Accounting Grade	mean	std dev
ACT I	49	56	48	38	16.48	4.56
II		51	54	39	18.26	5.29
III			70	45	17.62	5.31
IV				36	17.60	5.76
Accounting Grade					x 2.02	1.36

Table XIVa

Variable	B Values	F	t
ACT II	.0558	17.81	2.14
III	.0859	10.98	3.31

x Y intercept = -0.5138

R = .484
$S.E._R$ = 1.20

Table XV

GENERAL PSYCHOLOGY - MEN
N=181

	ACT II	ACT III	ACT IV	Gen. Psych Grade	mean	std dev
ACT I	47	51	50	38	16.16	3.99
II		44	42	40	20.04	5.20
III			67	55	18.55	5.32
IV				47	19.38	5.37
Gen Psych Grade					x 1.71	1.10

Table XVa

Variable	B Value	F	t
ACT II	.0404	33.53	2.80
III	.0960	46.37	6.81

R = .576
$S.E._R$ = .903
x Y intercept = -0.8781

Table XVI

GENERAL PSYCHOLOGY - WOMEN
N=204

	ACT II	ACT III	ACT IV	Gen Psych Grade	mean	std dev
ACT I	45	56	54	41	19.58	3.93
II		45	51	48	17.64	5.67
III			72	63	20.27	5.08
IV				51	19.52	5.67
Gen Psych Grade					x 2.22	1.04

Table XVIa

Variable	B Value	F	t
ACT II	.0440	59.03	4.05
III	.1062	76.88	8.77

R = .664
$S.E._R$ = .781
x Y intercept = -0.7075